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Design of Double-row Magnetic Cycloid Gearbox

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The paper deals with the issue of magnetism and its use in mechanical engineering as well as in other industries. Transmission systems are rather frequently present in almost every technical system. The purpose of each transmission system is to transform energy, based on which its quality can be assessed.
The main objective of this paper is the structural design of a magnetic cycloid gearbox, a detailed description of transmission kinematic analysis, elaboration of calculation models for FEM analyses consisting of the analysis of gearing power relations and calculation of maximum torque the gearing is able to transform.

Keywords: magnetic transmission, kinematic equations, stress analysis, gearset, cycloid gearbox

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Paper number: M201521

Briquettes Made from Wood Residues

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At logging and at the subsequent wood and wood semi-products treatment and also at fruit trees treatment the fine grained loose waste is arising, e.g. wood dust, saw dust, shavings, chips, bark etc. One of possibilities of its meaningful utilization is the briquetting technology, which product are briquettes determined for energetic utilization (combustion). In the paper the experimental results are published. The briquettes quality evaluation was their aim. For the tests pine bark chips, fir chips, spruce shavings, spruce sawdust, apple chips and cherry chips were used The basic physical-mechanical properties were the evaluation criteria. Following properties were determined: ash amount, gross calorific value, total moisture content, density, rupture force, length, diameter, weight and mechanical durability.

Keywords: wood, briquetting, wood briquettes, density, rupture force

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Paper number: M201522

Analysis of CT Stress during Horizontal Annular-Delivery Sand Fracturing

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The CT-conveyed hydrajet perforating and annular-delivery sand fracturing in horizontal well can meet the requirements of large-scale stimulated reservoir volume and separate-layer multistage fracturing. So it is always as an effective technique to stimulate low and ultra-low permeability reservoirs. Unfortunately,in the process of annular-delivery sanding fracturing, the CT will endures a larger piston force, the accuracy of fractured intervals and the security of fracturing string can't be guaranteed. In this paper, with the method of mechanical analysis on horizontal CT and numerical simulation on packer's anchorage force, we obtain the effect of CT pump rate on its stress: When CT pump rate is smaller, the maximum axial and Von Mises stress happen at the CT bottom, where there exists a risk of strength failure; As CT pump rate increases, axial stress and Von Mises stress decreases gradually; The maximum safety factor can be obtained at the CT critical pump rate. Therefore, for annular-delivery sand fracturing, we'd better insure CT pump rate more than the critical value.

Keywords: coiled tubing; annular-delivery sanding; critical pump rate; string stress; horizontal well

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Milling Stability Prediction on Small Radial Immersion – Comparison SD Method and ZOA Method

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Stability lobe diagram predicted by the zeroth-order approximation (ZOA) method and the semi-discretization (SD) method were compared. The methods yielded similar predictions for high radial immersions under the specified cutting parameters and the cutting tool modal properties. As radial immersion was decreased, the disagreement between the predictions of the two methods grew. For very low radial immersions, the predicted lobe diagram differed considerably. The most prominent difference was an additional set of lobes corresponding to the new type of instability, the period doubling bifurcation which was predicted only by the SD method. Numerical simulation verification of the stability boundaries confirmed that the predictions of the SD were more accurate than those of the ZOA method.

Keywords: Milling stability, Lobe diagram, Small radial immersion, SD method, ZOA method

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Paper number: M201524

Investigation of Vertical Vibration of a Vehicle Vodel Driving Through a Horizontal Curve

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The article deals with the problem of vertical vibration of vehicle model driving a horizontal curve of radius R = 100 m. A brief theoretical work on the topic is presented in the introduction part. Where a descriptions of the forces acting on the vehicle while passing through the curve are discussed. In the second part of this work, a detailed description of the vehicle model is given. The equations of motion of the vehicle model are then derived for vertical dynamic response of the mechanical system considered herein. Analysis of the effect of asymmetry is then performed when the vehicle is driving the curve at a constant speed v = 30 km/h, excited by general kinematic excitations. Firstly, the asymmetrical model is considered and the results are then compared to a fully symmetrical model.

Keywords: Vibration, Horizontal Curve, Vehicle Model, Equations of Motion

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Paper number: M201525

The Influence of Heat Treatment on Mechanical and Corrosion Properties of Wrought Aluminium Alloys 2024 and 6064

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This article deals with the influence of the alloy temper during heat treatment on mechanical and corrosion properties of aluminium alloys 2024 (Al-Cu-Mg) and 6064 (Al-Mg-Si). For the experiment initial alloy tempers 2024-T351 and 6064-T8 were heat treated to three conditions – underaged, peak aged (T6) and overaged – to simulate the circumstances during the manufacturing process. Structure of all conditions and tempers was observed. The mechanical properties – hardness, yield strength, ultimate strength and elongation – and corrosion properties – maximum depth of corrosion attack peneration and corrosion rate in Audi immersion test for automotive industry (internal standard PV 11 13) – were measured. Structures of investigated alloy show evidence of intermediate phases arrangement in the direction of plastic deformation and they do not change during heat treatment. The lowest hardness, yield strength and ultimate strength have the underaged samples, the highest hardness, yield strength and ultimate strength have peak aged (2024) or initial samples (6064). Elongation decreases with ageing time or ageing temperature. In case of alloy 2024 corrosion rate and maximum depth of corrosion attack penetration increase with ageing time or temperature, in case of alloy 6064 corrosion rate increases with increasing ageing time or temperature while maximum depth of corrosion attack penetration decreases. Both alloys are attacked by intergranular corrosion with initiating surface pits.

Keywords: Aluminium alloys, heat treatment, precipitatiton hardening, corrosion and mechanical properties.

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Thermally Stable Al-Fe Based Alloys Produced from Secondary Materials

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Aluminium alloys are characterized by favourable properties, e.g. low density, specific tensile or electric and thermal conductivity. The problem with conventional aluminum alloys is their low thermal stability. According to previous published work, transition metals such as e.g. iron, chromium or nickel, increase the thermal stability. These metals are often found in aluminum waste as undesirable contamination. In this work, the alloys made of aluminum and cast iron or stainless steel were tested, simulating aluminum waste with a high iron content. The materials were prepared by powder metallurgy – method of rapidly solidified particles. The results showed that these alloys exhibit excellent thermal stability.

Keywords: aluminium, recycling, powder metallurgy

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Paper number: M201527

Deformation Zone Distribution of Continuous Extrusion Process

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Experiments and numerical simulations were conducted to analyze the deformation zone of aluminum cable in the conform extrusion process, and complex metal flow is observed by finite element. In this report, detailed studies were especially focused on the width of the extruding dies mouth and leakage gap which influenced on the metal deformation, then the stress and strain distribution and contact force distribution of arbitrary step were obtained with respect to different technical parameters among random steps. Furthermore, the relationship between the parameters of Δh and W/H was given, indicating that the intense internal Shear Band-IISB and leak gap affect the metal forming behavior, and enlarge obviously plastic deformation zone in a certain range. Consequently, it's proper to be helpful for metal homogeneous deformation to reduce the entrance width of the extruding mold.

Keywords: Continuous extrusion, Deformation Zone Distribution, Mold Parameters

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Improving the Hydrogen Release Capacity of $NaBH_4$ Via Mediation of Catalysts with Rare Metal Compounds

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This paper reports on doping with the catalysts consist of rare metal compounds like Co_2B, $La(NO_3)_3$, $Ce(SO_4)_2$, $Ti(SO_4)_2$, $CeCl_3$, $LaCl_3$ and mixed catalysts for improving hydrogen release capacity of $NaBH_4$. The results show that the hydrogen generation volume (HGV) is about 10ml and the hydrogen generation rate (HGR) is very low when doping with $La(NO_3)_3$, $Ce(SO_4)_2$, $Ti(SO_4)_2$, $CeCl_3$ and $LaCl_3$. Comparatively, Co_2B presents favorable catalytic effect on hydrogen generation properties of $NaBH_4$. The study on the mixed catalysts find that the HGV of the samples doped with mixed catalyst of Co_2B and $Ce(SO_4)_2$ is the largest. Among all doped samples, the HGV of sample doped with $5Co_2B\backslash 2Ce(SO_4)_2$ is the largest about 317ml. Compared to all samples doped with mixed catalysts, the samples doped with mixed catalysts of Co_2B, $Ce(SO_4)_2$, $Ti(SO_4)_2$ and $CeCl_3$ presents the best properties of hydrogen release. However, compared to Co_2B, doping with other catalysts makes the hydrogen release time of $NaBH_4$ longer. Overall, $NaBH_4$ doped with the mixed catalysts of Co_2B, $Ti(SO_4)_2$ and $CeCl_3$ present the optimal HGV and HGR than doped with any other catalysts.

Keywords: Hydrogen Release Capacity, Rare Metal Compounds, Mixed Catalysts, Catalytic Effect

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Machining Process & Information Modeling Based on MBD Procedure Machining Cell

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To describe the machining process and information of mechanical parts in petroleum engineering, the paper defines MBD machining process model from the perspective of process parts; analyzes evolutionary law of geometric features information in the course of part machining process and creates the concept of procedure machining cell; makes clear description about machining process based on procedure machining cell sequence to achieve the expression of machining process information; analyzes geometric features of procedure machining cell, proposes extended AAG based on AAG by combing with examples and links with attribute information table to complete the modeling of geometric and non-geometric features information about procedure machining cell. The research made in this paper provides a basic framework for integration of process information in 3D CAPP system.

Keywords: MBD, Machining process, Procedure machining cell, Information modeling

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Polishing of CVD Diamond Films in Vacuum

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An efficient polishing process has been carried out at the polishing speed about 200 mm/s in vacuum with temperature of 850°C. With the polishing time reaches 120min, the surface roughness of polished could get to Ra0.016 compared to original Ra9.67. Mass loss rate per hour was used to quantify the polishing efficiency. Increasing the polishing pressure could get high mass loss rate, which could be used in the rough machining process. In fine machining process, the polishing pressure should be lower and the high polishing speed should be remained. The 3D morphology from atomic force microscope(AFM) shows there are some summits about 30-40nm in height, and the summits take into the shape of directional narrow cone.

Keywords: CVD diamond, Polishing, Vacuum

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Research of Loading of Structural Bonds Created with One-Component Epoxy Adhesives

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An adhesive bonding technology is a method of a connecting which is used at a construction of coach-works, agricultural machines etc. This method is suitable for workings with a serial production. Many research projects dealt with a preparation of adhesive bonds, degradation aspects etc. An area, which has not been properly investigated at present, is an influence of a loading speed on strength of the adhesive bond and a destruction time of the adhesive bond. Adhesive bonds are loaded by a different intensity and a speed at a practice.
The research focused on an evaluation of the influence of the loading speed at a temperature 22 ± 2 °C on the shear tensile strength, the time needed for the destruction and a failure area. Second part of the research was focused on the influence of a bending moment. This bending moment can be minimalized by using so-called underlaying sheet of metal. The underlaying sheet of metal was of a thickness corresponding to a thickness of the adhesive bonded material. Also a behaviour of the adhesive bonded material was observed within the research.

Keywords: Adhesive bond, bending moment, loading speed, time

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Influence of Cutting Tool Overhangs at Machining of Hardened Steels

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This article builds on existing results of testing hardened steel bearing ring machining. Grinding technology is preferably used for this area as a standard. Turning with cubic boron nitride has been used as an alternative machining technology. Results indicate that in mass production the values accuracy of degree IT 4 can be achieved. Arithmetic mean deviation of the profile is then in the range of Ra = 0.2 - 0.4 µm. During testing several kinds of cubic boron nitride material were used. The material that showed best results was chosen for further experiments. Subsequently it was tested under different cutting conditions on two types of machine tools. It was tested cutting in smaller range of depth of cut and wider feed values. The resultig feedrate and cutting depth which correspond to best result of arithmetic mean deviation of the profile Ra were selected from those tests. Subsequently, the testing was carried out at various cutting speeds and particularly at two different sizes of tool overhangs.

Keywords: hardened steel, CBN, cutting inserts, cutting speed

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Wear Simulation Modeling by Using the Finite Element Method

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We can define wear as a phenomenon, which humanity can't fully explain and many do not understand it well. It is known for several millennia. It's an action, which can't be avoided. Often it's a critical factor affecting lifetime of device parts, for example the wear of plain bearings in many rotational devices can affect the function and cause great damage to it. The presented paper deals with stress and contact pressure distribution simulated by the finite element method (FEM) and the development of a wear module for simulating sliding wear of materials. First the theory of wear is presented. The next section presents the development of an own wear module in MATLAB, which also deals as an interface between MATLAB and ABAQUS software. Finally the module is tested on a sliding wear testing problem which is simulated using ABAQUS and the simulation results are presented at the end.

Keywords: Finite element method, wear, sliding contact

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Production Method of Implant Prototype of Knee-Joint Femoral Component

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The paper deals with a design and construction of an implant prototype of a knee-joint femoral component with a complex shape mathematic description especially of functional (articulating) surfaces. The core of a technical solution labours under the thought of casing of femur distal part with a shell of certain thickness whereas a special area is used as a referential area defining an inner and outer shape of the shell. The area is marked, cropped and smoothed. It is the created area of the lower end of the patient femur respecting the overall curvature of the knee joint.
Within designing of the implant prototype of the femoral component of the knee-joint modern methods of getting CT data, their processing by CAD software called CATIA and subsequent post processing are applied.
The prototype implant of the femoral component of the knee joint is designed from processed CT data of the patient affected knee-joint (the femur distal part, a tibia proximal part). The 3D model of the implant prototype of the femoral component is created on the basis of data editing in CATIA software. The final 3D model is then located to the composition (a bone, the implant prototype) and using anchoring ribs it is fixed on the femur distal part.

Keywords: Knee-Joint, Implant Prototype, Femoral Component, Bone, CATIA

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Setup System of Selective Roll Cooling Based on Profile Prediction in Aluminum Hot Strip Mill

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In aluminum strip production, profile formed in hot rolling is critical to flatness control in the subsequent cold rolling, and selective work roll cooling is marked by the flexible control of complex high-order shape defects. Therefore, a setup system of selective cooling is developed to achieve the whole cross-section profile control in hot rolling. It includes a real-time work roll thermal model based on finite deference method and a strip profile predictive model based on RBF network. A spray pattern is obtained using an iteration method, as the "basic pattern" for the setup, for the situation when roll thermal contour need to be maintained. Based on the predicted profile error, adjustment of the basic pattern is made by fuzzy inference to get the final setup spray pattern, under which the profile error can be reduced during the threading.

Keywords: Shape Control, Work Roll Cooling, Finite Deference Method, RBF Network.

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Comparison of the Continuous and Intermittent Relaxation Test

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The article presents the measurement results of the relaxation of long-term loaded compression springs manufactured out of non-alloy steel. The goal was to determine the differences between the interrupted and uninterrupted tests. During the relaxation test that lasted 5000 hr in a laboratory with a temperature of 22ºC, initial shear stress set at a value of 30% of the ultimate tensile strength of the material, decreased the strength of the springs with a wire diameter of 1 mm by 3.6%, springs with a wire diameter of 3.15 mm by 2.5%, and springs with a wire diameter of 5 mm by 1.3%. The difference in the results was found in tests 16 times and 4 times interrupted to measure the current relaxation. The results of intermittent tests cannot be considered as relaxation values for statically loaded springs. Conversely, when determining the maximum tension of quasi-statically loaded springs with respect to the relaxation, the uninterrupted relaxation tests cannot be used.

Keywords: Compression springs, Patented wire, Long-term test, Room temperature, Static loading

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Paper number: M201537

Microstructure and Mechanical Properties of the Forged Mg-Gd Alloy

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The Mg-5.6Gd-0.6Y-0.4Nd-0.2Zn-0.2Zr (wt. %) alloy was prepared by metal mold casting. Then the alloy was subjected to hot forging. The microstructure and mechanical properties of the solution-treated, hot-forged and aged alloy samples were studied. The affects of deformation processes on the microstructure and mechanical properties were discussed, and the strengthening mechanisms of alloy were also investigated. The results revealed that the coarse second phases distribute along the dendrite boundaries in the solution-treated alloy. After hot forging, the second phases were broken into small particles and the grains get uniformity. Tensile test results showed that the strength of alloy was greatly improved after hot deformation processes. The forged alloy showed remarkable age hardening response at aging temperature of 180°C. The peak hardness was obtained by the time of 72h. The ultimate tensile strength and yield strength of the peak-aged alloy were 275MPa, 181MPa at room temperature, and 209MPa, 127MPa at 300°C, respectively. The high mechanical properties were mainly attributed to the fine microstructure and fine dispersed metastable precipitates in the matrix.

Keywords: Mg-Gd alloy; Microstructure; Mechanical properties; Strengthening mechanisms

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Research on Distribution of Residual Stresses of Cold Rolled Sheet Distorted Area Based on ANSYS

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Based on the value of longitudinal distribution of the residual stresses in the strip with the cold rolled strip in different forms under stress loading, this paper establishes a finite element model. According to the simulation analysis on different stress curve functions and under some coefficient combining conditions of different stress curve functions, it is discovered that the stress acting lengths and the features are completely different under the actions of even-degree and odd-degree stress functions, and under the even-degree function, the residual stresses are distributed evenly at the far end of the strip, and the length location of the point where the residual stresses tends to be stable on the strip are linearly related to the strip width; under the odd-degree function, the residual stresses are distributed linearly in the horizontal direction of the strip while without any changes along the strip length. According to the analysis results of the strip's shear stress, a little strip shear stress is not enough to produce deformation. The result of this paper has profound guiding significance for cold-rolled strip flatness closed-loop control. Only with different control strategies for different flatness deviations after fitting, can the quality of the strip steel flatness be improved more effectively, thereby reducing the impact of the lag in flatness detection on the strip flatness control as far as possible.

Keywords: Cold Rolling, Stress Function, Residual Stress, Finite Element

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Effect of Impacts on Human Head

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The article deals with experimental measurements of force effects that direct blow develops taekwondo sportsman. Power effects are captured using a high speed camera. Experimental measurements have confirmed the results of many scientific papers that deal with the measurement of the force effects of combat sports athletes, etc. There are described some methods that are used in medicine and biomechanics to view internal organs or injury detection.

Keywords: biomechanics, impact, deformation, measurement, human head

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Properties of Adhesives Used for Connecting in Automotive Industry

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An automotive industry belongs among the most important industrial branches in the Czech Republic as well as in the Europe. An adhesive bonding technology is a method of connecting which is used in many industrial branches nowadays. It also plays its irreplaceable part in area of a construction of automobile bodies. The adhesive bonding is the method which is easily implemented among requirements of a serial production. A strength and a reliability of adhesive bonded parts of automobile bodies and other traffic means are key. That is why adhesives used for the adhesive bonding in the automotive industry are characterized by their increased strength and resistance (e.g. adhesives Betamate). The paper describes the cohesive and strength characteristics of these adhesives. It focuses on a tensile strength, a hardness and a shear strength depending on a thickness of used sheets of metal when an increased thickness of the sheet of metal decreases its plastic deformation and so it decreases a liability of the adhesive bond to peeling.

Keywords: Bonding, Epoxy resin, Lap-shear strength

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Preparation of Ultra-Fine Grained Alloys Based on Fe-Al-Si And Ti-Al-Si Intermetallic Compounds by Powder Metallurgy Using the Mechanical Alloying

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Alloys based on the intermetallic phases are presently considered to be very promising materials for demanding technological applications in a wide range of industries. The biggest disadvantage of intermetallics is their low toughness at room temperature. One of the way how to increase their plasticity and eliminate susceptibility to low temperature brittleness is preparing intermetallic phases with ultrafine grain structure. The paper describes the preparation of ultra-fine grained alloys based on intermetallic phases by mechanical alloying and subsequent compaction by the "Spark Plasma Sintering" (SPS). Influence of the individual alloy components on the preparation and mechanical properties of intermetallics alloys were studied. The basic mechanical properties at room and elevated temperatures, resistance to high temperature oxidation and thermal stability of alloys were measured.

Keywords: powder metalurgy, mechanical alloying, intermetallics, ultra-fine grained

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Study on Mechanical Properties of the Composite Resin Matrix Fiber Reinforced

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Fiber reinforced polymer Resin matrix composites have the good performance, and it is widely used in various fields to release the impact load. Therefore, the study of stress and strain characteristics is quite useful to in providing the reliable basis for the structural design. The tensile test is one of the important methods to detect the mechanic property of the material, which can be used to observe the deformation behavior of the material. Reinforced materials are often added to improve the mechanical properties of the composites, and characteristics and mechanical properties of composite materials will be obvious anisotropic. Damage behavior of resin matrix composite material with fiber reinforced is complex, and mechanical properties of it are quite difficult to obtain just through the experiments, so the finite element method becomes a useful tool to get the mechanical properties. In this paper, we developed the conventional finite element method to investigate the mechanical properties of composites material. The verification proves that the modified finite element method can get much accurate results.

Keywords: Mechanical property; Composites; Resin based material; Fiber reinforced.

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Design and Implement of Infrared Thermography Detection System Excited by Pulsed Flash Lamp

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Detection system of infrared thermography technology was designed, taking a non-refrigeration focal plane infrared camera and the pulse flash heating system with high energy as the core. Combining with the performance parameters and structure features of the hardware equipment, integrated control system was designed. Meantime, the cover and reflector for the detection system were fabricated, which improved the uniformity and the utilization rate of energy for the thermal excitation source of the flash lamp. Based on the Delphi program, control, acquisition, processing and analysis system for the infrared image sequence were developed. And defect identification software was also researched which could implement the quantitative calculation and analysis for the parameters of defect size, location, perimeter, area and depth. Finally, experiments for metal and composite with flat bottom defects were carried out by the use of the detection system proposed in this study. The results show that the detection system has the advantages of well controllable performance, convenient operation, perfect detection effect, powerful image processing functions, which can meet the testing demand for engineering application.

Keywords: Pulsed flash lamp, Infrared thermography, Design of the detection system

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Studies of Turbidity in the Ultrasonic/Ceramic Membrane Combined Process

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The ultrasonic/ceramic membrane combined process was employed to have a better effect of the filtrated water quality. We set the ultrasonic frequency at 20 kHz and the corresponding power at 2kW. Innovatively we probed into different range of molar weight of organic matters in the filtrated water, and results showed that the ultrasonic/ceramic membrane combined process could change the distribution of micromolecule organic matters. We found that with the increasing of turbidity of raw water, the membrane flux decreased rapidly but the quality of filtrated water changed little. Studies on different range of molar weight showed that for the organic matters whose molar weight were below 1kD, higher turbidity had an optimistic effect on removing them while for those whose molar weight were above 1kD, the effect was reverse.

Keywords: Ultrasonic; ceramic membrane; molar weight

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